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REMARKS

Claims 1-43 are pending in the application.

Claims 1-15 and 18-30 stand rejected as being anticipated by Aarik. Applicants traverse and request reconsideration.

Claim 1 sets forth a deposition method that includes, among other features, at a first temperature, contacting a substrate with a surface activation agent and adsorbing a first layer over the substrate. At a second temperature greater than the first temperature, the first layer is contacted with a first precursor and a second layer is chemisorbed at least one monolayer thick over the substrate. Page 2 of the Office Action refers to "Experimental Procedure" (apparently page 260) of Aarik and alleges that Aarik therein discloses the subject matter of claim 1. The Office Action alleges that Aarik discloses the first temperature as 425°C and the second temperature greater than the first temperature as 700°C. The Office Action further alleges that Aarik discloses contacting a substrate at 425°C with TiCl₄ and adsorbing a first layer over the substrate and contacting the first layer at 700°C with H₂O and chemisorbing a second layer at least one monolayer thick over the substrate. Thorough review of Aarik reveals that such reference does not in any way disclose or even suggest the alleged teachings.

The "Experimental Procedure" of Aarik (page 260) merely describes atomic layer deposition (ALD) of TiO₂ using precursors TiCl₄ and H₂O. Page 260 states that "the films were deposited at the pressure of 250 Pa and substrate temperature of 425°C." Nowhere does the "Experimental Procedure" disclose or suggest ALD of TiO₂ at a temperature of 700°C. Nowhere does the "Experimental Procedure" disclose or suggest using both a first

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temperature of 425°C as well as a second temperature of 700°C. The "Experimental Procedure" does not in any way disclose or suggest a deposition method including a second temperature greater than a first temperature. Further, nowhere does the "Experimental Procedure" disclose or suggest contacting a substrate with TiCl₄ at 425°C and contacting with H₂O at 700°C. Given that none of the allegations of page 2 of the Office Action allegedly supported by the "Experimental Procedure" are in fact supported by such text, it is not seen how claim 1 can be considered anticipated by Aarik.

Applicants note that page 263 of Aarik states in column 1, lines 38-43 that "temperatures as high as 700°C are needed to cause partial phase transition from TiO₂-II to rutile in the case of ALD-grown films." However, such text does not disclose or even suggest contacting a substrate with a surface activation agent at a first temperature, adsorbing a first layer over the substrate, and contacting the first layer with a first precursor at a second temperature greater than the first temperature, as set forth in claim 1. Contrary to the Office Action allegations, such text further does not teach contacting a substrate with TiCl₄ at 425°C, adsorbing a first layer, and contacting the first layer with H₂O at 700°C. Aarik does not in any way suggest a deposition method that uses a first temperature of 425°C and a second temperature of 700°C in the same method. The Office Action alleges that such a teaching exists, however, Applicants' thorough review of Aarik does not reveal any such teaching and the Office Action does not provide a reference to any portion of Aarik that provides such a teaching.

If the Office is of the opinion that the "Experimental Procedure" in combination with some other portion of Aarik teaches the alleged subject matter, then the Office Action is

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defective for failure to comply with 35 CFR § 1.104(c)(2). The stated rule requires that "the pertinence of each reference, if not apparent, must be clearly explained." The Office Action does not state that any portion of Aarik other than the "Experimental Procedure" is pertinent. The Office Action does not refer to any portion of Aarik that describes a deposition method using a second temperature greater than a first temperature, as set forth in claim 1. Section 1.104(c)(2) also states that the particular part of a reference relied upon "must be designated as nearly as practicable." The Office Action does not indicate any part of Aarik relied on other than the "Experimental Procedure." The Office Action does not provide any explanation of teachings within different portions of Aarik that are combined in some way to provide disclosure or suggestion of the subject matter. Rather, the referenced part of Aarik allegedly relied upon is deficient in disclosing or suggesting the alleged subject matter. Accordingly, at least for failure to comply with 37 CFR § 1.104(c)(2), the rejection should be withdrawn.

Further, the Office Action does not provide an allegation that the teachings of page 260 can somehow be combined with the teachings of page 263. That is, the "Experimental Procedure" describes one method using a temperature of 425°C for both TiCl₄ as well as H₂O. Such text does not provide any mention of another temperature and does not describe using a second temperature for H₂O greater than a first temperature used for TiCl₄. Similarly, the text of page 263 merely states that temperatures "as high as 700°C" have been used in deposition methods and does not describe a second temperature for contacting H₂O greater than a first temperature for contacting TiCl₄. Page 263 does not provide any indication of using different temperatures within a deposition method. The

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Office Action does not provide any explanation of combining the teachings of page 260 with the teaching of page 263 to somehow achieve the teaching alleged on page 2 of the Office Action. Applicants assert that Aarik does not support any such rational.

Aarik does not disclose or suggest the deposition method of claim 1. Merely describing one method using a temperature of 425°C and a second method using a temperature of up to 700°C does not constitute teaching the one deposition method set forth in claim 1 of using a second temperature greater than the first temperature. At least for such additional reason, Aarik is deficient in disclosing each and every element of claim 1. Thus, Aarik does not anticipate claim 1. Applicants further assert that no suggestion exists in Aarik of the claim 1 method and that claim 1 is also patentable over Aarik.

Claims 2-15 depend from claim 1 and are not anticipated at least for such reason as well as the additional limitations of such claims not disclosed. For example, claim 2 sets forth that the first layer enhances a chemisorption rate of the first precursor compared to the substrate without the surface activation agent adsorbed thereon. Aarik does not provide any disclosure or suggestion that TiCl₄ enhances a chemisorption rate of H₂O on the substrate compared to the chemisorption rate of H₂O on the substrate without TiCl₄ adsorbed thereon. Page 2 of the Office Action alleges that Aarik discloses the deposition method of claim 2, but does not allege that Aarik discloses the first layer enhancing a chemisorption rate of the first precursor. The Office Action merely states that claim 2 is disclosed without explaining the pertinence of Aarik in such rejection and without designating the particular part of Aarik relied upon. At least for such reason, the rejection

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of claim 2 also fails to comply with the requirements of 37 CFR § 1.104(c)(2) and should be withdrawn.

Also, for example, claim 5 sets forth that the first temperature is less than a chemisorption temperature of the surface activation agent on the substrate. Aarik does not provide any disclosure or even a suggestion of such a feature of the first temperature. That is, Aarik does not disclose or suggest that 425°C is less than the chemisorption temperature of TiCl₄, the alleged surface activation agent. Aarik does not provide any discussion of the chemisorption temperature of TiCl₄ and cannot be considered to describe that 425°C is thus less than the chemisorption temperature of such compound. Page 3 of the Office Action alleges that the "Introduction," second paragraph of Aarik teaches the features of claim 5. However, in violation of 37 CFR § 1.104(c)(2) the pertinence of the cited text of Aarik is not clearly explained. In fact, no explanation whatever is offered in the Office Action of the pertinence of the cited text. The "Introduction," second paragraph describes that the crystal structure of TiO₂ films can be controlled by choice of substrate temperature in ALD processing. The cited text does not provide any other discussion of the significance of temperature. Clearly, the "Introduction," second paragraph does not identify a chemisorption temperature of TiCl₄ nor does it suggest a deposition method using a temperature that is less than the chemisorption temperature of TiCl₄. Thus, the art is deficient in disclosing or suggesting the alleged subject matter and the Office Action is deficient in complying with 37 CFR § 1.104(c)(2).

Further, for example, claim 13 depends from claim 1 and sets forth that the surface activation agent is the same as the first precursor. Page 3 of the Office Action alleges that

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Aarik discloses such a feature but again fails to comply with 37 CFR § 1.104(c)(2). Additionally, Applicants note that page 2 of the Office Action considers TiCl₄ to disclose a surface activation agent. In a deposition method according to claim 13, a substrate is contacted with a surface activation agent (TiCl₄) at a first temperature and a first layer adsorbed over the substrate. At a second temperature greater than the first temperature the first layer is contacted with a first precursor (also TiCl₄). Aarik does not in any way provide disclosure or suggestion of adsorbing a first layer of TiCl₄ at a first temperature and then contacting the first layer at a second temperature greater than the first temperature. Accordingly, Aarik cannot be considered to disclose or suggest the subject matter of claim 13.

Still further, for example, claim 12 sets forth that the method includes substantially displacing the first layer from over the substrate during the chemisorbing the second layer. Page 3 of the Office Action alleges that Aarik teaches the features of claim 12. Page 12, lines 3-13 and page 21, lines 8-17 provide a discussion of displacing the first layer from over the substrate, as set forth in claim 12. It is clear from the specification that "displacing" the first layer comprising adsorbed surface activation agent includes removing at least some of the surface activation agent from the substrate. The Office Action alleges on page 3 that formation of TiO₂ evidences substantially displacing TiCl₄ during ALD of H₂O. However, Aarik does not provide any disclosure or even a suggestion of removing TiCl₄ from a substrate during ALD of H₂O thereon. The oxygen of the H₂O merely replaces the chlorine of the TiCl₄. Such a reaction of H₂O with TiCl₄ does not, according to the

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express teachings of the specification, constitute "substantially displacing" TiCl₄ from the substrate.

Claim 18 sets forth a deposition method that includes, among other features, at an initial temperature less than a chemisorption temperature of a surface activation agent, adsorbing the agent over a substrate and, at a deposition temperature greater than the initial temperature, atomic layer depositing a first species over the substrate. Page 2 of the Office Action alleges that the Aarik "Experimental Procedure" teaches such a method. However, as can be readily appreciated from the discussion above regarding claim 1, Aarik does not disclose or suggest adsorbing a surface activation agent at an initial temperature less than a chemisorption temperature of the agent. Aarik also does not disclose adsorbing a surface activation agent at an initial temperature and atomic layer depositing a first species at a deposition temperature greater than the initial temperature. At least for such reason, in addition to the reasons described above regarding the deficiencies of the Office Action in complying with 37 CFR § 1.104(c)(2), Aarik does not anticipate claim 18.

Claims 19-25 depend from claim 18 and are not anticipated at least for such reason as well as the additional limitations of such claims not disclosed or suggested. For example, claims 19, 22, and 24 depend from claim 18 and set forth additional features somewhat comparable to the additional features set forth in respective claims 2, 13, and 12. At least for the reasons set forth above regarding claims 2, 13, and 12, claims 19, 22, and 24 are not anticipated by or obvious over Aarik.

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Claim 26 sets forth a deposition method that includes, among other features, adsorbing a surface activation agent over a substrate with at least an outer surface of the substrate being at a first temperature less than a chemisorption temperature of the agent and altering a temperature of at least a portion of the substrate. A monolayer of a first compound is chemisorbed over the substrate with at least an outer surface of the substrate being at second temperature greater than the first temperature, substantially displacing the agent from over the substrate. A monolayer of a second compound is chemisorbed on the first compound monolayer. Pages 2-3 of the Office Action allege that Aarik discloses the method of claim 26. However, as can be appreciated from the discussion above regarding claims 1, 5, and 12 Aarik does not disclose or suggest adsorbing a surface activation agent over a substrate at a first temperature and chemisorbing a monolayer of a first compound over the substrate at a second temperature greater than the first temperature. Aarik also does not disclose or suggest that the first temperature is less than a chemisorption temperature of the agent. Aarik further does not disclose or suggest chemisorbing the monolayer of a first compound and substantially displacing the agent from over the substrate. Accordingly, Aarik does not anticipate claims 26. Applicants further assert that rejection of claim 26 is improper at least for the deficiencies of the Office Action discussed above regarding 37 CFR § 1.104(c)(2).

Claims 27-30 depend from claim 26 and are not anticipated at least for such reason as wells as the additional limitations of such claims not disclosed. For example, claims 27 and 30 set forth additional features somewhat comparable to the additional features set

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forth in respective claims 2 and 13 discussed above. At least for the reasons discussed above regarding claims 2 and 13, claims 27 and 30 are also not anticipated by Aarik.

According to Applicants' remarks above regarding claims 1-15 and 18-30, Aarik does not anticipate any of such claims. Applicants further assert in keeping with earlier assertions, that claims 1-15 and 18-30 are patentable over Aarik. Additionally, pages 2-3 of the Office Action rejecting such claims fail to comply with 37 CFR § 1.104(c)(2) and withdrawal of the rejection or correction to comply with the rule is required. Applicants request allowance of claims 1-15 and 18-30 in the next Office Action.

Claims 16 and 17 stand rejected as being unpatentable over Aarik in view of Sherman. Applicants traverse and request reconsideration.

Claims 16 and 17 depend from claim 1, the subject matter of which is discussed above. Page 4 of the Office Action acknowledges that Aarik fails to teach the subject matter of claims 16 and 17 and relies on Sherman as allegedly providing the missing disclosure or suggestion. However, Sherman fails to remedy the multitude deficiencies of Aarik discussed above with regard to claim 1. Accordingly, both Aarik and Sherman are deficient in the same respects of failing to disclose every element of claims 16 and 17 depending from claim 1. Combination of Aarik or Sherman cannot be somehow considered to disclose or suggest the subject matter that is absent from both. At least for such reason, claims 16 and 17 are patentable over Aarik in view of Sherman.

Claims 31, 34, 36, and 38-43 stand rejected as being unpatentable over Aarik in view of Doering. Applicants traverse and request reconsideration.

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Applicants note that the Office Action does not provide a rejection of claims 32, 33, 35, and 37, however, page 6 provides a discussion of such claims in view of Aarik and Doering. Accordingly, Applicants assume that the Office intended to reject claims 31-43 as being unpatentable over Aarik in view of Doering. If Applicants' assumption is incorrect, then claims 32, 33, 35, and 37 should be considered patentable over all cited art.

Claim 31 sets forth a deposition method that includes, among other features, contacting a bulk semiconductor wafer with a cooling medium to establish at least an outer surface of the wafer at an initial temperature, contacting the wafer with a surface activation agent, and adsorbing a first layer on the wafer, the initial temperature being less than a chemisorption temperature of the agent. The method includes placing the wafer on a heated wafer chuck, establishing at least the outer surface of the wafer at a deposition temperature greater than the initial temperature, contacting the first layer with a deposition precursor, and chemisorbing a second layer at least one monolayer thick over the wafer. Page 5 of the Office Action alleges that Aarik discloses the subject matter of claim 31 except for placing the wafer on a heated wafer chuck. The Office relies on Doering as allegedly disclosing placing the wafer on a heater wafer chuck.

As can be appreciated from the discussion above regarding claims 1 and 5, Aarik does not disclose or suggest adsorbing a first layer of a surface activation agent at an initial temperature and contacting the first layer with a deposition precursor at a deposition temperature greater than the initial temperature. Also, Aarik does not disclose or suggest that the initial temperature is less than a chemisorption temperature of the surface activation agent.

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In addition, Aarik does not disclose or suggest contacting a bulk semiconductor wafer with a cooling medium. The Office Action attempts to rely on a portion of the "Experimental Procedure" section describing purification of carrier gas with "an adsorption trap cooled down to 100K." Such text merely describes a well known gas purification method for nitrogen gas used to remove impurities by adsorption of the impurities onto a trap cooled down to 100K. Disclosure of gas purification with an adsorption trap does not in any way disclose or suggest adsorption of a surface activation agent in a deposition process. Such gas purification further does not in any way disclose or suggest applying a cooling medium to a bulk semiconductor wafer to establish at least an outer surface of the wafer at an initial temperature in a deposition method. The "Experimental Procedure" clearly states that the precursors were deposited at a substrate temperature of 425°C and does not suggest that a cooling medium was used to establish the substrate temperature. Aarik does not disclose that the carrier gas was used to control substrate temperature at 425°C. A carrier gas purification method using a cooled adsorption trap does not in any way suggest using the carrier gas as a cooling medium to establish at least an outer surface of a bulk semiconductor wafer at a particular initial temperature. At least for the enumerated reasons, Aarik fails to disclose or suggest the subject matter of claim 31.

Review of Doering reveals that such reference does not remedy the deficiencies of Aarik discussed herein. Accordingly, both references are deficient in the same respect of disclosing every element of claim 31. A combination of such references cannot be considered to disclose or suggest the subject matter missing from both references. Claim 31 is thus patentable over the cited combination.

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Claims 32-43 depend from claim 31 and are patentable at least for such reason as well as for the additional limitations of such claims not disclosed or suggested. For example, claims 38 and 41 depend from claim 31 and set forth additional features somewhat comparable to the additional features of claims 2 and 13 discussed above. At least for the reasons discussed above regarding claims 2 and 13, claims 38 and 41 are patentable over the cited art. Aarik does not disclose or suggest the subject matter of claims 38 and 41 and Doering does not disclose and is not alleged to disclose or suggest the subject matter of claims 38 and 41.

Regarding claim 38, page 5 of the Office Action alleges that Aarik discloses the subject matter of such claim because "it is well known that monolayer of oxygen are always forming on silicon because of there strong bond and by heating the wafer, the processes reduces that particular chemisorption rate." It is apparent that the alleged disclosure in the art of the subject matter of claim 38 is based on facts within the personal knowledge of the Examiner. As allowed by 37 CFR § 1.104(d)(2), Applicants hereby call for support of the allegation by affidavit of the Examiner's personal knowledge or the submission of further art that can be reasonably combined to support the Office's position. Further, Applicants note that claim 38 sets forth that the surface activation agent "enhances" (indicating an increase of) a chemisorption rate of the deposition precursor compared to not using the surface activation agent. In contrast, the teaching alleged by the Office of oxygen forming on silicon is stated to reduce chemisorption rate. Accordingly, even if the Office establishes the purported well known teaching with an affidavit or further art, the purported teaching still would not disclose or suggest the subject matter of claim 38.

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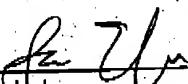
At least for the reasons described herein, claims 31-43 are patentable over Aarik in view of Doering, considered alone or in combination. Applicants request allowance of such claims in the next Office Action.

Applicants herein set forth adequate reasons for allowance of claims 1-43 and hereby request such allowance of all pending claims in the next Office Action.

Respectfully submitted,

Dated: 03 Jul 2002

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